

(Insert Title picture:

Maui Invasive Species Committee 2001 Action Plan)

[NOTE: This is a TEXT-ONLY version of this document. Page numbers may not exactly match the original document's.]

**PROJECT UPDATE
SPRING 2001**

PROJECT SUMMARY

The Maui Invasive Species Committee (MISC), a partnership of 16 government, private, and non-profit organizations, will continue control and eradicate priority incipient invasive plant and animal species that threaten the State's most intact federal, state, and private conservation lands and 79 federally-listed endangered plant species. MISC's goal is to eradicate or control newly established pests before they expand beyond control, so as to preserve the State's native species, environment and economy.

PROJECT ABSTRACT

Hawaii is in the midst of an invasive alien species crisis affecting the archipelago's highly endemic biota, overall environmental and human health, and the viability of its tourism- and agriculture-based economy. Because of the vulnerability of isolated oceanic islands to invasion, aggressive plant and vertebrate species exploit and modify all but the most resistant native ecosystems in protected areas of Maui. The introduction of alien species has been the predominant cause of biodiversity loss in Hawaii for the past century, with more native species eliminated in this state than anywhere else in the United States. Federal, state, and private managers of protected areas on the island of Maui are struggling, with some success within their narrow jurisdictions, to reduce the impacts of alien species on native biota so as to prevent further ecosystem degradation and loss of biodiversity, but invasions outpace resources and successes are only temporary, given continued invasion from beyond their boundaries.

The Maui Invasive Species Committee (MISC), a federal-state-private partnership, has coalesced to bring about joint action to prevent, contain, or eradicate the most serious incipient plant and animal invasions. Although MISC formed in December 1997, the organizations involved in MISC have been working together successfully against alien invasions since 1991. MISC provides a much-needed model that has obtained major state and county funding and has been adopted on two other islands, enhancing conservation efforts statewide. In its first year, MISC received almost \$800,000 in funding from federal, state, county and private sources. **MISC partners include Haleakala National Park (NPS), U.S. Geological Survey-Biological Resources Division (USGS/BRD), USDA Forest Service (FS), U.S. Fish and Wildlife Service (FWS), Hawaii Army National Guard, USDA Tri-Isle Resource Conservation and Development Council, Inc., Hawaii Department of Land and Natural Resources (DLNR), Hawaii Department of Agriculture (HDOA), University of Hawaii, Maui County's Office of Economic Development, Maui County Board of Water Supply, The Nature Conservancy-Hawaii (TNC), Maui Land & Pineapple Co. (ML&P), and Community Development Block Grant Program.** MISC also encourages participation of the Maui Association of Landscape Professionals, Hawaii Nurseryman's Association, Maui Chamber of Commerce, Maui Hotel Association, Maui Visitors Bureau and similar industry associations, businesses, and trade groups in its committee meetings. Public education and publicizing success stories are crucial ingredients of the anti-invasive species strategy.

Since initial funding in the fall of 1999 MISC has made considerable progress in surveying, treating and eradicating Maui's most serious plant and animal threats, while avoiding the creation of new bureaucratic processes. MISC has established a fully equipped and operational office, baseyard, and full-time staff of eight including an extensively trained field crew. The new MISC headquarters and base-yard is centrally located in Maui, enabling field work to be accomplished effectively at all island sites. To date, MISC and its partners have treated over 1200 acres of *Miconia*-infested rain forest, surveyed and mapped crucial treatment areas of all target species, and conducted significant control work on all known major infestations of the six worst priority incipient pest plants on Maui. In 14 months, MISC has made significant progress in meeting major goals: 1) surveying, mapping, and controlling Maui's worst weed, *Miconia*; 2) surveying and eradicating Fountain grass; 3) eradicating or controlling known populations of Pampas grass, Ivy gourd, Giant reed, and Rubber vine; 4) mapping Caribbean frog populations and controlling new populations while they are still small; and 5) surveying flocks of parrots and parrot-type birds.

In its 2nd year, MISC seeks to continue efforts to proactively eradicate and/or contain invasive species that threaten the numerous ecosystems of Maui, including Haleakala National Park, the most biologically intact summit-to-the-sea reserve in the Hawaiian Islands and among the most important reserve sites in the United States for conservation of biodiversity. Survival of 79 endangered plant species and important state and private conservation lands (TNC's Waikamoi and Kapunakea Preserves, Maui Land & Pineapple Company's Puu Kukui Preserve, several state Natural Area Preserves, and many other as yet undesignated natural areas) will ultimately be jeopardized unless the invasive plant and animal species targeted by MISC are contained or eradicated. The State's continued financial support of this initiative in its 2nd year would help MISC achieve its goal: to protect Maui's most intact ecosystems, overall environmental and human health, and the viability of the tourism- and agriculture-based economy from the significant threat of additional alien plant and animal invasions.

MAUI INVASIVE SPECIES COMMITTEE (MISC)

2001 ACTION PLAN

PROJECT NEED

HAWAII'S ALIEN SPECIES CRISIS.

Alien species are increasingly recognized as a threat to biological diversity and human welfare worldwide. A recent article in the journal *Science* stated: "Many fear that another century or so of frenetic international traffic will lead to an 'ecological homogenization' of the world, with a small number of immensely successful species" (Enserink 1999). Oceanic islands are particularly vulnerable to invasive species, and Hawaii especially so because of its role as a transportation hub. Because of their evolution in isolation from many forces shaping continental organisms, ecosystems of the Hawaiian Islands are perhaps an order of magnitude more vulnerable than most ecosystems of the continental U.S. Hawaii has one-third of the endangered species in the United States, and invasive alien species pose the greatest threats driving these and other native species toward extinction. More native species have been eliminated in Hawaii than anywhere else in the United States, yet these islands still retain more native biodiversity than the famous Galapagos. Although habitat destruction has been an important cause of extinction and endangerment, the introduction of alien species has been the predominant cause of biodiversity loss in Hawaii for a century. The island of Maui alone has 79 federally listed and candidate plant species and as many additional species classified as "species of concern" by the U.S. Fish and Wildlife Service. At the same time, invasive species pose huge threats to Hawaii's tourism-based economy, agriculture, health, and general quality of life, and Hawaii's residents are beginning to recognize the problem. The pervasiveness of this issue for society in Hawaii provides hope that it may be possible to marshal adequate resources to address the problem in the necessary comprehensive fashion. These islands are natural fortresses, surrounded by large expanses of ocean. Given rational management based on good science and with the help of informed citizens, this problem can be addressed.

THE MAUI INVASIVE SPECIES COMMITTEE: THE NEED FOR CONTINUED FUNDING OF INVASIVE PEST ERADICATION

Resource managers recognize that although active on-site vigilance and management are essential for protecting native ecosystems, long-term protection of these areas may depend more than anything else on the success of keeping new alien plant and animal species from becoming established and spreading on an island-wide level. Preventing establishment and spread of new introductions is not only cost-effective, but essential.

Likewise, managers recognize the need to work together on invasive species problems and solutions. MISC is a grass-roots partnership that has the capacity to survey, map, and control incipient invasive pests, acting as both a rapid response team and as a long-term invasive species management program. Two other islands have followed Maui's lead. The Big Island (Hawaii) established a Melastome Action Committee (BIMAC) in 1995 and expanded focus to become an Invasive Species Committee (BIISC) in 1999, and Oahu formed an Invasive Species Committee (OISC) in the fall of 2000. Oahu has a great advantage in that *Miconia* was discovered at an early stage and is considered under control and near eradication. Each island has a different mix of agencies, personalities, and interest groups, and each can contribute uniquely toward effective grassroots action against invasive species which pose common threats island wide. Maui's successes and failures in particular guide efforts statewide. In

addition, the ISCs have the potential for contributing to national and world models for such efforts.

MISC's primary target continues to be the invasive tree *Miconia calvescens*. This species, native to neotropical forests at 1000-6000 ft elevation, is now known to be an unusually aggressive invader of moist tropical island habitats. Introduced to Tahiti in 1937, dense thickets of *Miconia* had by the 1980s replaced the native forest over most of the island, with dramatic reduction of biological diversity. A 1997 paper by J.-Y. Meyer and J. Florence (*Journal of Biogeography* 23:775-781) states that 40-50 species endemic to Tahiti are on the verge of extinction primarily because of the invasion of *Miconia*. After the late botanist F.R. Fosberg saw this species in Tahiti in 1971, he reported that "it is the one plant that could really destroy the native Hawaiian forest." Yet because of its attractive purple and green foliage, it had already been brought to Hawaii as an ornamental in the 1960s, and no sustained efforts were made to control it until it was well established on Hawaii Island.

After the detection of *Miconia* on Maui by conservation agencies in 1990, an alarm was raised. Now *Miconia* has become something of a household word on Maui and progress is being made to control it. However, despite the considerable progress made, *Miconia* will continue to be a primary target for years to come for several reasons. *Miconia* can produce large amounts of seeds per year; it can occasionally flower and seed below the forest canopy, unseen during helicopter surveys; some seeds can remain dormant in the soil for up to six years before germinating; and the majority of *Miconia* on Maui grow in areas that are difficult to access even for control crews.

The management challenges for *Miconia* provides one example of why committed, long-term funding is crucial to the effective control strategy for Maui's worst pests. Populations of target species remain, established seed banks persist, landowner access is pending in some areas, additional areas remain to be surveyed, and there is a steady stream of new introductions that have the potential to devastate Hawaii's economy, environment, and quality of life. Furthermore, public education about invasive species issues needs to continue and expand, for without the public's support, we will not succeed. MISC is committed to long term, sustainable efforts. The State's continued support of MISC in its 2nd year will help guarantee these objectives are achieved.

OBJECTIVES & METHODS

1. *Miconia calvescens*

Objective: *Miconia* continues to be the primary target species of MISC and all known populations in the wild are being mapped and treated. Unfortunately, experience in French Polynesia and Hawaii has shown that some trees, even fruiting trees, are missed by ground crews and aerial surveys during the first pass, necessitating repeated survey and treatment. Also, the well-documented dynamics of *Miconia* re-establishment after removal within plots on Raiatea, French Polynesia (Meyer and Malet 1997), suggests a minimum of 4-5 years from seed germination to fruit production and a dormant seed life of about six years in the soil seed bank; dynamics of East Maui *Miconia* populations closely resemble those found for Raiatea. The second year's effort involves re-survey and re-treatment of all areas known to have had *Miconia* as well as areas nearby. This is necessitated by the presence of a viable seed bank with a dormant seed life of about six years at the location where any *Miconia* tree reached

reproduction. In these cases revisit by the ground crew will be most effective. Aerial surveys will be increased where cost effective.

A Maui *Miconia* control strategy meeting was held on May 24, 2000 and included representatives from Haleakala National Park, Department Land and Natural Resources- Division of Forestry and Wildlife, U.S. Geological Survey-Biological Resource Division and MISC. The purpose of the meeting was to evaluate the effectiveness of the control program to date and plan future strategies. The product of this meeting is a revised multi-faceted strategy for MISC's 2nd year plan with the following goal:

To control Miconia on Maui by focusing on the sustained long-term, island-wide goal of "Zero Fruiting Trees".

In particular:

- Concentrate on killing flowering trees around population perimeters, working from the periphery towards the cores as in fighting a fire.
- Implement an overall increase in aerial reconnaissance, to determine boundaries of core and satellite populations
- Increase aerial spray operations with flowering trees as the first priority
- Follow-up ground surveys to look for sub-canopy *Miconia* in areas around trees spotted by air
- Track, record, and map all ground and aerial control work with GeoExplorer 3 Global Positioning System hardware supported by GPS Pathfinder Office Data Processing software by Trimble Navigation, and ArcView GIS/ Geographic Information System mapping software by ESRI Inc.
- Increase road access up Kawaipapa Gulch.

Methods: The strategy against *Miconia*, first presented at a public meeting in Hana, Maui, in December 1993, and as revised resulting from the May 2000 strategy meeting at the MISC office involves the following basic elements:

a) **Helicopter spraying of herbicide as a holding action to limit seed production, especially in inaccessible sites.** The herbicide (Garlon 4, ester formulation of triclopyr) is applied with surfactant and dye. The dye allows the pilot to judge application rate and aerial extent with precision accuracy, and identify treated plants.

b) **Development of access routes to allow on-the-ground control.** Access routes developed by bulldozing in 1996-98 through rough lava terrain to allow on-the-ground control at the Hana *Miconia* core population will be maintained and a road will be expanded into the Kawaipapa River area. Six miles of 4-wheel-drive roads are in place, subdividing the 2500-acre primary infestation site into management units and allowing efficient access.

c) **Mechanical/chemical removal by workers on the ground.** A Hana-based 5-man crew was hired in June 1996 and has been working full time to remove *Miconia* at the Hana-core population ever since. The 5-man MISC crew is assisting in the core area and removing all other peripheral populations.

d) **Continuing public information and surveillance for new locations.** Activating all Maui communities to locate plants remains an essential strategy for containing *Miconia*. MISC continues the Nature Conservancy's program of successfully using public outreach/education within the East Maui communities of Keanae, Nahiku, and Huelo as a monitoring strategy to locate plants within known populations and to locate previously unknown invaded sites. Solicitation of information from pig hunters, hikers, and other residents will be continued.

e) **Measures to prevent seed dispersal by *Miconia* workers.** Whenever *Miconia* or any other target species control is undertaken, a supervisor oversees adherence to a strict protocol of decontamination safeguards. *Miconia* workers are required to wear conspicuously marked footwear and other gear which are "dedicated," i.e. used only for work involving *Miconia*. Currently MISC crews have 4 sets of dedicated gear: 2 for *Miconia* (permitting work situations where more heavily contaminated areas are visited before cleaner areas and decontamination washing is not possible in the interim), one for Pampas grass work, and one for "clean" or pristine areas.. Whenever bulldozers and other vehicles are used in *Miconia* areas, they are *always* pressure washed immediately afterwards.

f) **Support for biological control.** Biological control is regarded as a highly welcome adjunct to mechanical/chemical efforts, to reduce recovery potential through reduction in leaf growth and reproduction. In mid-November 1997, the fungus *Colletotrichum gloeosporoides* f. sp. *miconiae*, which may prove to reduce vegetative growth of *Miconia*, was released by Dr. Eloise Killgore (Hawaii Department of Agriculture) within the East Maui Hana population, which may prove to reduce vegetative growth of *Miconia*. Other biocontrol efforts are in progress.

g) **Monitoring of progress.** To date, helicopter survey provides the best method of determining the presence of fruiting trees. We will implement an overall increase in aerial reconnaissance to determine peripheral boundaries of core and satellite populations.

2. Pampas grass (*Cortaderia jubata*)

Objective: Treat all known populations and survey potential habitat. This species is recognized as one of the worst invasive weeds in natural areas of California, is also invasive in New Zealand and South Africa, and was added to the Hawaii Noxious Weed List in 1993. It was discovered on Maui by Haleakala/ USGS-BRD in 1989. Pampas grass has the potential to invade Haleakala Crater and shrubland of Haleakala on a large scale. Distribution data showed that Pampas grass has invaded numerous areas of rain forest/bog on East and West Maui (Kahakaloa Natural Area Reserve). Aerial surveys this year showed that *Cortaderia* has invaded the rain forest of the East Maui watershed more extensively than previously thought. Viable seed persists in the soil seed bank for at least 6 years. In the second year, all populations in the wild will be re-visited and re-treated as necessary and aerial reconnaissance will be continued over inaccessible watershed areas. By June 30, 2001, all known populations of *Cortaderia jubata* on Maui should be treated at least once.

Methods: The ground crew utilizes chemical and mechanical control methods developed in California and New Zealand. In residential and urban areas, where *Cortaderia* is planted ornamentally and where the use of herbicides is discouraged, plants are dug out of the ground utilizing brushcutters and pulaskis. Aerial reconnaissance is employed where roads are lacking at high elevations. Helicopter spraying will continue to be used as an effective tool for attacking *Cortaderia* populations detected by aerial monitoring, especially in very sensitive high elevation watershed areas where minimal disturbance to surrounding vegetation is desired. The herbicide (Rodeo/glyphosate) is applied with surfactant and dye allowing precision and accuracy of application rate, aerial extent, and to identify treated plants. HDOA will be called upon to assist MISC crew in dealing with recalcitrant landowners, if needed. A conspicuous campaign of public education will be continued in the local media.

3. Fountain grass (*Pennisetum setaceum*)

Objective: Treat populations and survey potential habitat. In 2001, populations will be re-treated with the goal of eliminating all persisting individuals. In addition, incipient populations of fountain grass on Molokai will be controlled or eradicated through joint action with The Nature Conservancy- Molokai, and the Hawaii Dept. of Agriculture. MISC will pursue assisting the Kahoolawe Island Reserve Commission (KIRC) with the eradication of populations in the former military installation on the island of Kahoolawe.

Methods: Highly flammable fountain grass, *Pennisetum setaceum* (on Hawaii's Noxious Weed List), has been recognized since the 1960s as a threat to agriculture and natural areas of Maui. Ground and aerial surveys are used to locate and map population, followed with chemical control by the ground crew using Velpar (hexazinone) herbicide. Search-and-destroy missions will be repeated in areas of one mile radius around previously known populations (ground and aerial survey); follow-up evaluations will be conducted twice yearly in the 6-8 Maui sites known to have ever had fountain grass. Comprehensive aerial surveys of the Kanaio National Guard training area, western leeward Haleakala and lower Ulupalakua Ranch lands will be repeated seasonally when *Pennisetum* is in bloom. Color posters will continue to be distributed to likely sources (National Guard people, garden shops, botanical gardens, Kanaio and other leeward land owners, cowboys, golf course managers, strategic landowners in proximity to known populations, hunters that Ulupalakua Ranch allows on their lands, DLNR employees, Hawaiian settlement people at Kahikinui, etc.).

4. Ivy gourd (*Coccinia grandis*)

Objective: Treat all individuals of all known populations and conduct comprehensive surveys of areas near known infestations. In year two, all sites known to have ever had Ivy gourd will be re-treated.

Methods: This species (on Hawaii Noxious Weed List) exploded in the 1980s on Oahu and in the Kona area of the Big Island, creating huge problems for agriculture and conservation of lowland sites. It was first found and removed on Maui in 1992, and is probably still eradicable, because of its dioecious condition (both male & female plants generally necessary for pollination and seed set). Problems: 1) Once seeds are set, seed bank persists for at least 3-4 years, and 2) More and more plants are being found on Maui by MISC. MISC will followup initial control of known populations and survey nearby areas. Ivy gourd is controlled by removing and bagging all ripe fruits and treating stems with a thin-line basal bark application of Garlon 4 (triclopyr). Records will be kept of populations that appear to have fruited and have persisting seed banks.

5. Giant reed (*Arundo donax*) and Rubber vine (*Cryptostegia grandiflora*)

Objective: All known populations will be removed in 2001. Monitoring of treated sites, with re-treatment if necessary, will be done in the second year. For Giant reed (*Arundo donax*), survey work has resulted in a number of new site records this year. Surveillance for new location records will be continued.

Methods: Chemical treatment of *Arundo donax* with Roundup Pro (glyphosate) herbicide or mechanical removal with pulaskis will continue. Control methods obtained from the California Exotic Plant Pest Council have been modified by results from controlled field trials conducted on Maui by the MISC crew. *Cryptostegia grandiflora* is expected to require minimal need for follow-up, although some re-treatment with Garlon herbicide is anticipated for Year 2.

6. Other Invasive Plants

Objective: MISC will continue to assess an additional thirteen invasive plant species for potential future control. Although the crew is devoting little significant time to these species during the first

two years of the MISC plan implementation, MISC will continue to survey and monitor each species and seek systematic reporting of observations by others. Peripheral populations may be treated with herbicide to prevent further spread. These species are: Banana poka (*Passiflora mollissima*), Fire tree (*Myrica faya*), *Tetrastigma pubinerve*, Victorian laurel (*Pittosporum undulatum*), Cat's claw (*Caesalpinia decapetala*), Himalayan raspberry (*Rubus ellipticus*), Malabar melastome (*Melastoma candidum*), Mullein (*Verbascum thapsus*), Downy rose myrtle (*Rhodomyrtus tomentosa*), Allspice (*Pimenta dioica*), kudzu (*Pueraria lobata*), German Ivy (*Delairia odorata* = '*Senecio mikanioides*'), and *Macaranga tanarius*.

Methods: The MISC public relations specialist will inform the green industry, state and private agencies, and the public to be on the lookout for these species and report occurrences to MISC for mapping.

Objective: Prevention of new invasions. On a grand scale, MISC measures progress in terms of pest infestations contained or eradicated.

Methods: One significant example of the prevention work that MISC does and will continue occurred in June 2000. MISC was approached by the landscape architect designing the enclosure for the Gorilla Foundation, which will house 'Koko' the gorilla and her mate 'Ndume' on a piece of private land on Maui. The landscape architect gave MISC a list of over 665 species of alien plants they were considering introducing for forage or landscaping, many of which would have been invasive in Hawaii, and some of which are illegal to import into Hawaii. The landscape architects are providing full cooperation and continue to allow MISC to screen and revise the list so that this is a win-win situation for both Maui and the endangered gorillas.

7. Caribbean Frogs (genus *Eleutherodactylus*)

Two species of small brown Caribbean frogs of the large Neotropical genus *Eleutherodactylus* have been introduced to Hawaii in the past 10 years or so. One of these species (*E. coqui*) occurs on Maui; the second (*E. planirostris*) occurs on the Big Island, Oahu, and Kauai and could easily be transported to Maui. *E. coqui* is colloquially called "coqui", while *E. planirostris* is referred to as the "greenhouse frog". Both species reached Hawaii and are being spread around the State in nursery materials--this is the well-documented means of spread of these and related species throughout the Caribbean region as well. *E. coqui* is well studied in its native Puerto Rico and from these studies we can readily deduce the problems this and related species could cause in Hawaii should they become widespread. Basic ecological information relevant to determining these effects include the following:

1. The frogs can occur at densities up to 8,000 per acre, and may occur at higher densities in Hawaii
2. They consume an average of 45,000 prey items per acre per night (approximately 16 million prey items per acre per year)
3. They do not require standing water for a tadpole stage, eggs are laid in leaf axils or in leaf litter
4. Females produce 4-6 clutches per year, each clutch consisting of 16-41 eggs
5. The frogs reach sexual maturity 8 months after being laid as eggs; and
6. They can occur from sea level to at least mid-elevation rainforest and mesic forest (ca. 4000 feet).

As a result of these ecological attributes we may expect that, if left unchecked, these frogs will soon spread and establish numbers on Maui too large for control. If so, it is reasonable to expect that they will have the following negative effects on Maui's native species and ecosystems:

1. They will exert a tremendous predation pressure on a wide array of native nocturnal invertebrates, including insects, spiders, and snails, many of which are already stressed to the edge of extinction;

2. By removing a large percentage of the insect prey base, they will have a large indirect effect on Maui's remaining native forest birds, most of which are partially or largely insectivorous;

3. They may serve as a food source for rats and mongooses, allowing these predators to reach even higher densities than occur now and thereby increasing the predation pressure these alien mammals exert on Maui's native birds, tree snails and plants; and
4. They may serve as a potential food source for any snake species that may become established on Maui in the future, thereby making it easier for any such snakes to maintain artificially high population densities, as has occurred with the brown treesnake on Guam.

Another negative consequence of these frogs' establishment on Maui is that their loud calls (emitted at 90-100 decibels) prove very annoying and disturbing to the sleep of many locals and visitors. Visitors at several hotels on Maui have complained about the noise at night, and some residents have even threatened to leave Maui if the frogs could not be removed. These complaints have stemmed from areas having no more than 30 – 80 frogs, not the thousands that the species are capable of attaining. It is also possible that the frogs may serve as vectors of plant nematode eggs by having them adhere to their skins, increasing an already significant problem for some sectors of the horticultural industry. Further, if states such as California discover that Hawaiian nurseries are contaminated by these frogs, they may refuse shipments of material not certified to be free of the pests, again increasing costs to the industry generally.

Objective: Continue to verify and document locations and sizes of Caribbean frog populations on Maui. Control new, localized individuals to prevent new infestations, with priority given to locations that sell or rent plants. Eradicate as many established populations as feasible.

8. Escaped Parrots and Parrot-like Birds

A variety of parrot species have been released by pet owners and have established populations in the wild on Maui and the other main Hawaiian Islands, in some cases for many years now. However, it is unknown exactly how many and which parrot species are established on Maui, what the population sizes are, where they roost, or how successfully they are breeding and increasing their numbers. Sightings of flocks of birds have been documented by DLNR Forestry and Wildlife staff for Mitred conures (*Aratinga mitrata*), two Amazon parrots (*Amazona* spp., probably one species is the Blue-fronted Amazon), the Rose-ringed parakeet (*Psittacula krameri*), the Ring-necked parakeet (*P. alexandrinus*), Peach-faced lovebirds or a hybrid-form (probably *Agapornis* spp.), as well as a White cockatoo (*Cacatua* sp.). All of these previously listed forms probably represent species which are breeding in the wild on Maui and are persisting in small to moderate numbers. Furthermore, DLNR-DOFAW staff observed at least three other taxa that may not represent breeding populations. A variety of parrot species are well-known agricultural pests elsewhere in the tropics, typically targeting fruit and grain crops, and they have reached sufficient numbers that control measures have been required on Kauai.

They pose additional threats to native ecosystems in two ways. First, because of the long distances they frequently fly, they are efficient dispersers of seeds for a variety of invasive plant species. Furthermore, the fact that several parrots at loose in Hawaii are of much larger size than other alien bird species makes it likely that they will disperse seeds from alien plants having large fruits that are currently not a problem in the State. In it's native range, mitred conures are known to feed upon *Miconia* berries and thus may also contribute to the spread of this major invasive threat on Maui. Second, introduced parrots are also effective seed predators of some tree species and eat the crowns of other trees, causing their death. This has resulted in the decimation of native palm trees in Palau, for example. It is possible that they could serve to inhibit reproduction in native tree species whose seeds they might eat, serving to reduce native plant populations. They are also a likely threat to Maui's native Loulu palms, which are already endangered.

Objective: Conduct a one-year intensive field study of parrots on Maui to ascertain numbers, exact species composition (s) and breeding status, diets, and the foraging patterns of these birds on Maui and to gather all necessary information on activity patterns to design effective removal strategies for the future.

9. Snakes, Rabbits, and other Vertebrates

A variety of other alien vertebrates that are not currently known to be established on Maui still show up on the island at frequent intervals. These animals, which include snakes, lizards, turtles, frogs, and rabbits, are thought to be animals released by pet owners. Other vertebrate pests, such as bulbuls, may potentially arrive on Maui from neighboring islands. To avoid having these animals establish populations on Maui, it is imperative that reported sightings of any new vertebrate pests be quickly responded to in order to capture the reported animal. Furthermore, the large number of reported sightings of snakes on Maui since August, 1997, and the clustering of these sightings in two geographically limited areas raises the concern that some species of moderately large snake may be in the process of establishing a population on Maui. Evaluation of this possibility is currently hampered by the lack of sufficient personnel to respond effectively to each sighting.

Objective: Assist State DLNR personnel in responding to any and all such reports of new alien vertebrates so as to increase the likelihood that these species will be prevented from establishing on Maui.

10. Nursery surveys and education by MISC

Objective: Nursery education to discourage sale of invasive species and provide information about the spread of Caribbean frogs.

Methods:

- Collaborate with a USGS-BRD-funded project on Maui started in the summer of 2000 developing methodologies for early detection of incipient invasions.
- MISC/USGS-BRD will work with the cooperation of the Maui Farm Bureau, the Maui Association of Landscape Professionals, and the Maui Outdoor Circle to educate nurseries about new potential invasives.

11. Public Relations and Education

Objective: To educate the public and get their assistance to stop the problem, to cultivate a positive organizational image, and to make MISC's actions visible, a public relations strategy and educational outreach program utilizing all forms of media is being conducted to reach a broad audience.

Methods Public awareness objectives are being met by:

- Distribution of information at community events, presenting slideshows and talks at schools and community meetings.
- Presentation of invasive species information through newspaper articles, periodicals, trade journals, and television to a local, statewide, and national audience.
- Continued development of an Internet website (see link at www.hear.org, Hawaiian Ecosystems at Risk) to provide access to a wide range of data as well as the committee's plans, strategies, and decisions.

EVALUATION

MISC's annual planning is done in workshops devoted to the topic. The most recent of 3 all day workshops was held Sept.15, 2000. MISC has regular 3-hour meetings throughout the year at 4-6 week intervals to make crucial decisions, guide strategy, and give direction to and to receive feedback from the MISC coordinator. To date, all decisions have been reached by consensus. Additionally, all day meetings of sub-committees are convened to review and revise strategy for control work on selected priority target species. Separate *Miconia* and *Cortaderia* strategy workshops were held this spring with another scheduled in November to re-evaluate new data on *Cortaderia*.

The MISC Coordinator and Public Relations Specialist are responsible for documentation of all MISC activities, monetary expenditures, and accomplishments in terms of area surveyed/treated and plants removed/treated. Maps of known locations of all target species (including annotation with population structure, fertility and history of control efforts) are being kept and updated as new reports come in. Special attention is given to all populations of all target species which appear to have fruited and have persisting seed banks. The MISC Coordinator, with assistance the Data Specialist, Public Relations Specialist, and Field Crew Supervisor, are responsible for follow-up evaluations and reporting results to the MISC committee regularly at periodic MISC meetings. Short-term and long-term control operations are aimed at exhausting the seed banks established by previously controlled plants. Careful GPS data archiving and mapping of all of the information gathered is evaluated to generate an effective follow-up schedule for re-treatments.

RESULTS TO DATE

The first year's objectives are being met by MISC's full-time staff and its partners: surveying, treating and controlling or eradicating Maui's most serious plant threats. The operational office and baseyard, with staff of eight including an extensively trained field crew, are fully equipped with computers, office and field equipment, safety gear, radios, and vehicles. Surveys of target species by ground and aerial transects using GPS computers are followed by mechanical/chemical removal by workers on the ground or aerial spraying of inaccessible plants. The crew is trained in both Global Positioning System (GPS) use and generation of Geographic Information System (GIS) map products. This essential mapping of survey and biological data of all target species provides a strategic resource for action and evaluation, guiding day-to-day control work that will continue in the future.

The MISC database and field record system was developed to provide a seamless and compatible link with the largest existing databases in the county and the state, including those maintained by Haleakala National Park Resource Management, the U.S. Geological Survey Biological Resources Division, and agencies on Oahu, Hawaii, and Kauai. The mapping products being generated are available to all resource management agencies, public and private.

Public awareness objectives are being met by distributing information at community events and by slideshows and talks given at schools and community meetings. Information on invasive species has been presented through newspaper articles, periodicals, trade journals, and television to a local, statewide, and this January and March, to a national audience (ESPN and the Discovery Channel).

Results for specific objectives:

See locations of species on p. 15; aerial survey and spray records on p. 16

***Miconia calvescens*:**

- Entire 1200 acre Hana "primary core" treated once by the DLNR crew.
- Entire "secondary core" of Lower Nahiku surveyed and treated once by MISC crew.
- Total of 256.5 crew days (1 crew X 8 hrs.) on 10 peripheral populations by the MISC field crew (surveys, on-the-ground transects, and/or treatment (chemical or mechanical)).
- Total of 18,753 plants killed in peripheral populations by ground crew: 681 seeding trees; 1109 trees 3-6m; 16,963 < 3m .
- 7 helicopter spray operations conducted killing uncounted 100's of seeding trees.
- 18 aerial search missions conducted locating new trees/populations. Data points taken during aerial searches allowed ground crew to navigate back with GPS on the ground, locate, and kill trees.
- New isolated "outlier" trees located in East Maui at 2000 ft elevation and 1.5 mi from nearest known population (possible result of bird dispersal or of inadvertent human dispersal). "Outliers" have been removed or treated, either by aerial spraying or by crews on the ground.

Pampas grass (*Cortaderia jubata*):

- Killed approximately 60% of known *Cortaderia jubata* on the island.
- The four largest infestations (all close to native forest and watershed) treated, revisited, and retreated.
- 10 aerial search missions conducted locating new plants/populations in natural areas and watersheds.
- All known populations in the wild mapped and aerially sprayed. Potential habitat systematically surveyed. Data points taken during aerial searches allowed ground crew to navigate back with GPS on the ground, locate and kill plants.
- 4 helicopter spray operations conducted killing 210 seeding plants in both East & West Maui.
- Total of 145.6 crew days of control work at 34 locations (incl. 23 residential addresses).
- Total of 1,623 plants killed by ground crew in natural and residential areas and approximately 10,150 seed heads cut, bagged and buried on site.
- MISC negotiated key contracts for aerial spray and survey operations with Haleakala Ranch and East Maui Irrigation, a subsidiary of Alexander & Baldwin, two large private landowners controlling thousands of acres of critical watersheds and native forests. Access to these lands has been vital for controlling Pampas grass that threatens Haleakala National Park, native forests and watersheds.

Fountain grass (*Pennisetum setaceum*)

- All 3 known populations on East Maui treated in the first year.
- Extensive follow-up surveys conducted and continue to monitor possible persisting seed banks. Surveys up to one half-mile around known plants completed. Few plants found during recent revisits. One-mile radius surveys scheduled for after the next rainy season.
- Total of 50 crew days (1 crew X 8 hrs.) of control work.
- Total of 348 plants killed, including 23 seeding.
- Population on West Maui, (treated in past years by the state DLNR) re-surveyed in October, and re-treatment in progress.
- A comprehensive aerial survey conducted of the Kanaio National Guard training area and lower Ulupalakua Ranch lands (western leeward Haleakala) covering 20,000 acres of land and consisting of flights over 3 days. Trained technicians, skilled in spotting fountain grass in aerial searches, from Hawaii Volcanoes and Haleakala National Parks, Hawaii Army National Guard, and Hawaii DLNR served as observers. No plants discovered, suggesting population successfully removed.

Ivy gourd (*Coccinia grandis*):

- Total of 35.2 crew days of control work.
- Total of 1211 plants killed; 254 fruits collected.
- 3 known large infestations (Kapalua, Honokahua, and Kihei) treated and revisited/retreated 1-3 months after initial treatment.
- Field crew conducted numerous surveys in susceptible habitat (including door-to-door in residential).

Giant reed (*Arundo donax*):

- MISC crew conducted successful controlled and replicated method field trials. Methods obtained from California Exotic Plant Pest Council were modified by results
- Total of 24 crew days of control work.
- Total of approx. 1650 plants killed at previously known 2 large sites.
- 8 new small populations located by survey work.

Rubber vine (*Cryptostegia grandiflora*):

- All known plants killed: Total 5 plants at 2 sites.
- Total of 1.5 crew days of control work.

Caribbean frogs (*Eleutherodactylus spp.*):

- Frog reports were taken and investigated. Verified reports were mapped and populations estimated, and information was collected to determine the point of origin.
- MISC crew responded to reports of single or small populations in new locations to control and eradicate frogs before they spread.
- Posters, articles, press releases were done and nursery visits were conducted by staff to raise awareness and reduce the spread of new populations.

Parrots and Parrot-type birds: Mitred conures (*Aratinga mitrata mitrata*)

- MISC supported a baseline study of one of the parrot species of concern. Positive identification, population trends, range, habits, and food items were studied.
- Observations of other species of parrots and parrot-type birds were collected in preparation for more extensive survey work.

Public Awareness:

- A public relations campaign and educational outreach program was conducted utilizing all forms of media. Reached a broad audience: publicized MISC's actions, enlisted strong public cooperation and assistance, cultivated a positive organizational image.
- Information distributed at community events, slideshows, and talks given at schools, community meetings, and professional association meetings (e.g.: Maui Association of Landscape Professionals, and Hawaii Nurseryman Association).
- Articles on the invasiveness of several species printed in newspapers, periodicals, and trade journals and newsletters.
- Television exposure to local, statewide, and, this January and March, to national audiences. Filming segments will be aired on ESPN and The Discovery Channel in January and April 2001.
- Three community television productions aired repeatedly since September 1999: broadcasting MISC's mission, and assuring landowner consent, access and minimal controversy.
- An Internet website has been developed (see link at www.hear.org) providing access to a wide range of data as well as the MISC committee's plans, strategies, and decisions.
- Informational "Invasive Alien Species" posters and flyers were posted throughout major island towns.

PROJECT SUPPORT

WHY SHOULD STATE, COUNTY AND PRIVATE ENTITIES SUPPORT THIS PROJECT?

Use of State funds is particularly cost effective in this case because of the effective leveraging by federal, county, and private funds. In 1999-2000, the award of federal funds, by the National Fish and Wildlife Foundation, the U.S. Fish and Wildlife Service, the U.S. Forest Service, in addition to non-federal matching funds from the Maui Board of Water Supply, the Maui County Council, and The Nature Conservancy, led to 2:1 matching for state funding, much of which might not have been obtained without the award of the non-state funds. This year MISC submitted a grant to the National Fish and Wildlife Foundation at a 1:1 match, as many of the initial start-up costs were met last year.

Miconia, Pampas grass, Fountain grass, Ivy gourd, Caribbean frogs, and other species being addressed by MISC pose serious threats to state and private conservation reserves, to county watersheds, agriculture, tourism, and to the quality of life of all Maui residents and visitors. The Maui tourism industry is proud of the fact that Maui has been chosen the "Best Island in the World" for five consecutive years by Conde Nast Traveler magazine. MISC's activities to stop incipient alien species are devoted to maintaining Maui's high-quality environment in spite of an onslaught of alien plant and animal invasions.

Figure 1

(Insert Map: MISC Target Species Locations)

Figure 2

(Insert Map: MISC Aerial Reconnaissance and Control Spray Operations)